PATENT SPECIFICATION 1,127,514
DRAWINGS ATTACHED.

1,127,514

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Int. Cl.:—B 04 c 3/00.

COMPLETE SPECIFICATION.

Cyclone Separator.

We, AKTIEBOLAGET BAHCO, a Swedish Company, of Sturegatan 38, Box 245, Stockholm, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to a cyclone with an axial gas intake and an axially displaceable guide vane ring, the cyclone being better capable of separating particles suspended in a gas at varying load conditions, than prior art cyclones of this type.

The separating ability of cyclone separators is essentially dependent on two factors; these being the tangential velocity component of the rotating flow of gas, imparting to the particles suspended in the gas a centrifugal acceleration out towards the periphery of the separator, and the radial velocity component of the gas flow, in towards the centre of the separator, which through the medium of frictional forces strives to drive the particles with the gas out through the central discharge means, intended for purified gas. A certain, theoretical particle size exists in equilibrium between these forces, which can be designated the limit size for the cyclone separator and constitutes an essential factor with respect to its efficiency.

In cyclones provided with an axial gas intake it is possible to increase the separation promoting tangential component by suitable means, such as passing the gas between guide vanes at an angle sharply inclined to the axial direction of the separator.

The tangential velocities which can be applied in practice, however, are restricted, because the pressure losses and wear increase proportionally with the square of the tangential velocity. For the purpose of attaining maximum separation efficiency it is also important to maintain the tangential velocity at values permissible with respect to resistance and wear, when the separator is loaded with light gas flows, e.g. caused by a reduction in the rate of flow of gas from a thermal process.

The object of the present invention is to provide a cyclone having an axial intake the design of which cyclone is such that the tangential component can be controlled and maintained on reduction in the flow of gas.

The present invention provides a cyclone separator having an axial gas inlet at one end and a central tube, serving as a gas outlet, at the other end, and guide vanes for imparting a rotary movement to the flow of gas wherein the guide vanes form part of a guide vane ring which is provided axially adjustable relative to the jacket of the cyclone and positioned in a tapering portion of the said jacket, in the proximity of the gas inlet of the cyclone.

The angle at which the guide vanes are inclined towards the axis of the cyclone is preferably so steep that if the guide vane ring is displaced completely into the conical inlet seating the maximum permitted tangential velocity is attained even with a very small part flow of gas. When the flow of gas is increased the guide vane ring is displaced out of its seating, an annular clearance being formed around the said guide vane ring. In this way large or small amounts of non-rotating gas can be allowed to by-pass the guide vane ring, into the cyclone and by mixing the flow of gas through the guide vane ring, this gas being imparted a rotary movement, with the non-rotating gas passing outside said ring in proportion determined by the axial displacement of the guide vane ring, the rota-

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tion of the gas in the interior of the separator can be regulated to any desired amount for all gas loads.

Since the pressure losses in the apparatus are a measurement of the intensity of rotation, displacement of the guide vane ring can be selected according to a measured or sensed value of the drop in pressure, either manually or fully automatically (mechanically).

The ability of the guide vane ring to be displaced axially can be provided for by securing the ring centrally on a tube which protrudes into the centre of the cyclone and runs in neck bearings supported by the central tube of the cyclone. Thus it is also possible to provide for repeated cleaning of the central tube on changes in load, by providing the said tube with scraper means.

Several cyclones can be connected in parallel and provided with a common driving means connected to the tube which supports the guide vane ring, so that all the cyclones are regulated in unison.

The invention will be more closely described below with reference to the accompanying drawings, where

Figure 1 is a perspective view, partly cut away, of an embodiment of the cyclone according to the invention, provided with an axially slotted central tube;

Figure 2 is an enlarged view of a longitudinal section through the cyclone according to Figure 1, showing the guide vane ring; and

Figure 3 is a cross-section of an array of cyclones showing the cyclones according to the invention connected in parallel.

The cyclone in Figures 1 and 2 comprises a cylindrical jacket 1 provided at the top with a tapering portion 2, at its inlet end. An axially displaceable guide vane ring 3 is concentrically arranged in the portion 2 on a tube 4, arranged coaxial with the jacket 1, and intended to deflect the axially flowing gas into a helical flow path, and to regulate the ensuing rotation of the gas. The top of the coaxial tube 4 is secured with one end of a transversal rod 5, fastened at its other end to the wall of the jacket 1, by locking means 6 which passes through the wall of the jacket in a slot 7, located in said wall and extending longitudinally of the cyclone. The slot 7 is covered by a sealing plate 8. Because the locking means is displaceable in the slot it is possible to move the rod 5 parallel to itself, and thus also the tube 4 and the guide vane ring 3 attached thereto, in an axial direction. The axial tube is accordingly slidably mounted in neck bearings 9, in the centre of the axially slotted central tube of the cyclone. The central tube is formed of two arcuate sections 10, connected together along their inner long edges over the neck bearings 9, and fastened at the bottom in the bottom plate of the cyclone, in an opening therein. The sections thus give the central tube, seen in cross-section, an S-shaped appearance. The outer long edges of the sections are cut obliquely so that the width of the slots to the channels extending axially in the central tube tapers off towards the gas exhaust vent at the bottom of the cyclone, to enable a uniform distribution of the inflowing gas through the slots along the length of the central tube. The lower end of the central tube projects downwards, away from the bottom plate somewhat, and opens out into a tubular stubpipe 12 for the gas, the stubpipe 12 being secured to the underside of the bottom plate of the cyclone. The bottom plate is provided with openings 13 through which particles separated in the cyclone are led away to ducts 14 which are attached to the under face of the bottom plate, and communicating with outlet stubpipes 15. The central tube is provided with scraper means 16 which are attached to the tube 4 and intended to free the slots from deposits. This cleaning action is, as already mentioned, made possible by the fact that the tube 4 can be displaced axially, so that the scraper means are capable of being moved up and down. Thus on each occasion that the guide vane ring is moved to regulate the flow an automatic cleaning of the tube is simultaneously effected.

The array of cyclones shown in Figure 3 comprises a jacket 21 in which a plurality of cyclones 22 are arranged in parallel with one another and which are provided with a common outlet 23 for the cleaned gas. The cyclones are each provided with a slotted central tube 24 opening out into the common outlet, a tube 25 being slidably mounted in the centre of said tube 24 and coaxial with the same. The upper end of the tube 25 supports a guide vane ring 26, arranged in a tapering portion at the inlet end of the cyclone. All of the tubes 25 are fastened at the top to a rod 27, extending at right angles to the same and capable of being raised and lowered parallel with itself by means of a link system 28, so that the guide vane rings can be adjusted to the selected position in the tapering portion of the cyclones.

The cyclones shown in the figures may also be provided with pressure-sensing means (not shown), which measure the pressure drop in the apparatus. These could then control regulating means which automatically displace the guide vane ring to set the optimal rotation intensity with respect to separation efficiency, e.g. the means shown in Figure 3. Alternatively, the pressure-sensing means may be connected

to an indicating instrument, which can be read when manually adjusting the guide vane ring, as is the intention with the cyclone shown in Figure 1.

Although the invention has been described with reference to a vertical cyclone it can be adapted equally as well to other cyclones, such as horizontal ones.

Attention is drawn to our co-pending Application No. 11664 of 1967 (Serial No. 1,127,513) which relates to similar subject matter.

WHAT WE CLAIM IS:—

1. A cyclone separator having an axial gas inlet at one end and a central tube, serving as a gas outlet, at the other end, and guide vanes for imparting a rotary movement to the flow of gas wherein the guide vanes form part of a guide vane ring which is provided axially adjustable relative to the jacket of the cyclone and positioned in a tapering portion of the said jacket, in the proximity of the gas inlet of the cyclone.

2. A cyclone separator as claimed in Claim 1, wherein the outer contours of the guide vanes are conical in shape, tapering off in the direction in which the gas flows.

3. A cyclone separator as clamed in Claim 2, wherein the guide vane ring is secured to a carrier means axially displaceable relative to the longitudinal axis of the cyclone.

3. A cyclone separator as claimed in Claim 3, wherein the carrier means is mounted in the central tube.

5. A cyclone separator as claimed in any one of the preceding claims, wherein the cyclone is provided with means which automatically adjust the axial position of the guide vane ring to the current gas flow.

6. A cyclone separator as claimed in Claim 5, wherein the said means comprises pressure-sensing means which measure the pressure drop in the cyclone, and setting means which are controlled by the pressure-sensing means and displace the guide vane ring in an axial direction.

7. A cyclone separator as claimed in any one of Claims 1 to 4, wherein the guide vane ring is manually adjustable.

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1127514 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

Fig.1

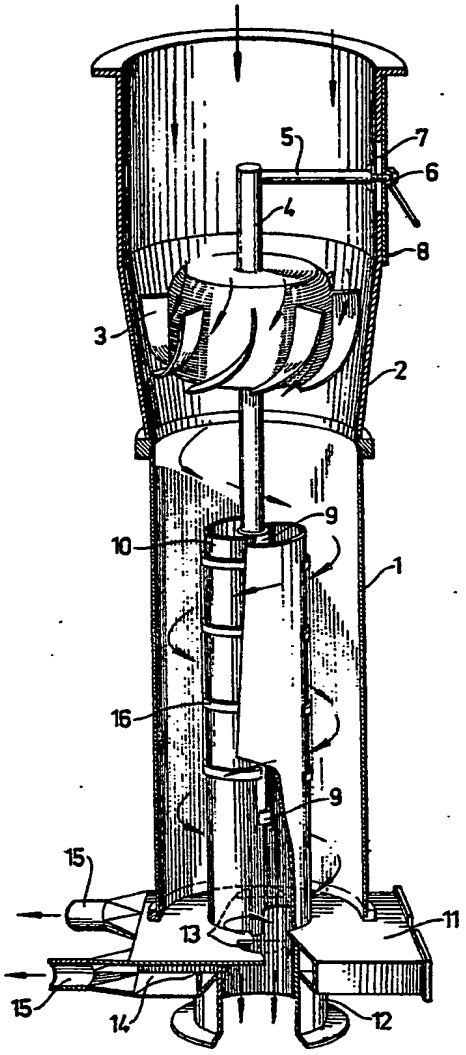
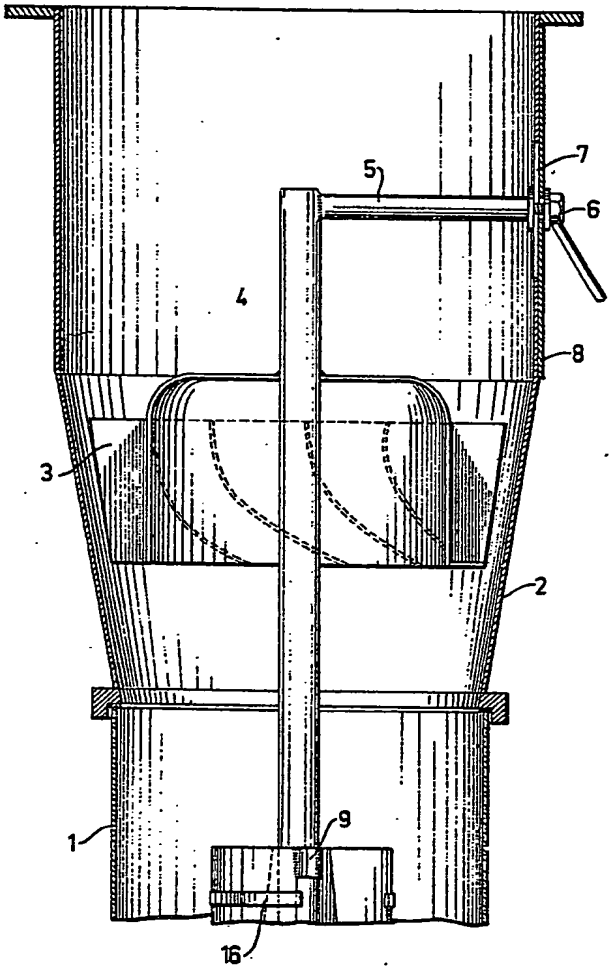


Fig.2



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Sheets 2 & 3

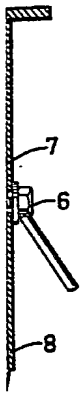
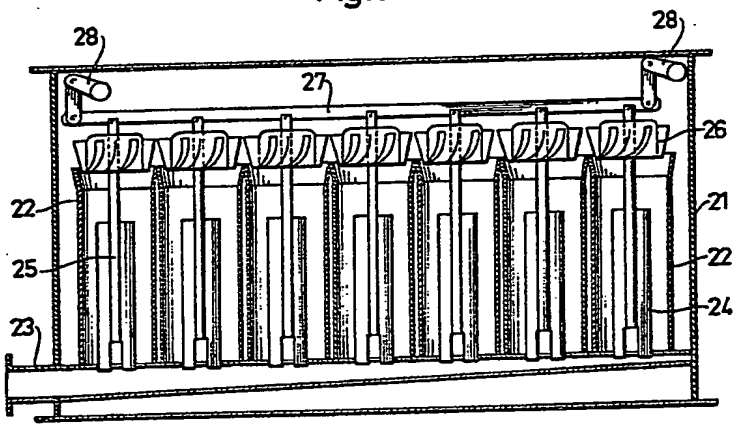


Fig.3



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3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 2 & 3

Fig.2

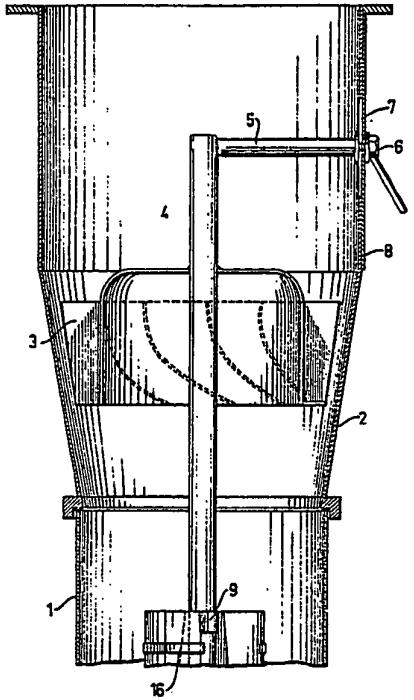
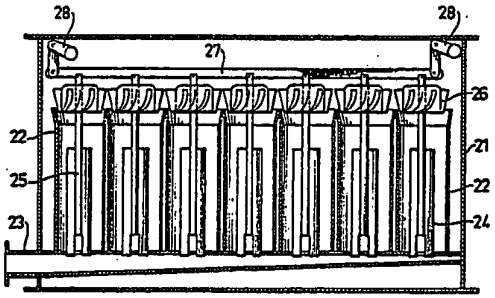


Fig.3



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